

## SCAPHOPODA OF THE SAN DOMINGO TERTIARY.

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This account of the Scaphopods of the San Domingo tertiary strata variously denominated Miocene or Oligocene, is an outcome of investigations undertaken by the writers in the course of work upon a monograph of the Scaphopoda published in the "Manual of Conchology." It is based upon collections made by W. M. Gabb, and briefly described in the Transactions of the American Philosophical Society.

Owing probably to Gabb's illness when he prepared the palæontological part of the "Geology of San Domingo," and to his death before its publication, the study of his material seems to have been incomplete. Our examination of the material shows that of six species described or recorded by him from the beds in question, *Dentalium rudis* is the tube of a Serpuloid worm; *D. ponderosum* is, as Guppy has already claimed, a form of *D. dissimile* of the Jamaican Oligocene; *D. affine* bears a preoccupied name, and *Gadus dominguensis* is not that species, but a new one allied to the form called *Ditrupa dentalina* by Mr. Guppy. Among the specimens of the species discriminated by Gabb, and in several trays of undetermined specimens, we have been able to distinguish ten new and well-characterized forms, besides several which are probably distinct species, but being represented by young or very fragmentary individuals have been ignored in the following account.<sup>1</sup>

As to the age of the deposit in San Domingo furnishing these remains, and that of the same horizon at Bowden, Jamaica, there is diversity of opinion. Gabb and some others have considered it Miocene; and in view of the considerable number of species still existing in the Gulf of Mexico, and the close relationship of many of the extinct forms with living species, this estimate is not without support. Conrad, however, in 1852<sup>2</sup> and again in 1866<sup>3</sup> expressed

<sup>1</sup> Among these, fragments of a species probably referable to our subgenus *Episiphon* may be mentioned. This group is represented in the German Oligocene by *Dentalium otto* Sharp & Pils.

<sup>2</sup> Proc. Acad. Nat. Sci. Phila., 1852, p. 198.

<sup>3</sup> Check List of the Invertebrate Fossils of North America, Eocene and Oligocene. Smiths. Misc. Coll., VII, no. 200, p. 37.

his belief that the San Domingo deposit was Oligocene. This opinion has recently been re-affirmed by Dall<sup>4</sup> who considers the Bowden marls of Jamaica and the beds of similar age in Santo Domingo to be upper Oligocene.

In considering so small a fragment of the fauna as the *Scaphopoda* constitute, a full discussion of this question is uncalled for; the more because the Scaphopods afford no conclusive data.

*Key to species of Scaphopoda.*

I. Shell largest at the aperture, tapering to the apex,

DENTALIUM.

a. With distinct longitudinal sculpture.

b. Circular sculpture conspicuous; tube slowly tapering.

c. Somewhat compressed; sculpture of many longitudinal cords alternating with threads, crossed by close, circular lamellæ.

*D. callioglyptum.*

c'. Circular in section; sculpture of many longitudinal alternately smaller threads, crossed by regular, blunt, obliquely encircling striæ,

*D. Tryoni.*

b'. Circular sculptured inconspicuous.

c. Tube markedly conical, with 6 or more ribs at apex, secondary and numerous tertiary riblets developed in the intervals, *D. gabbi.*

c'. Tube very slowly tapering, with six narrow, distant and sharply defined longitudinal ribs; intervals wide and plain, *D. Cossmannianum,*

c''. Square at apex, with 4 ribs, numerous threads soon developing in intervals but lost on larger part of tube, which is circular and smooth,

*D. dissimile* and var. *ponderosum.*

a'. No longitudinal sculpture.

b. Tube nearly or quite circular in section, almost straight, slender, considerably tapering; smooth and polished, *D. haytense.*

b'. Tube ovate in section, being laterally compressed; slowly tapering, thin, smooth; apex with a terminal "sheath" and v-shaped slit, *D. pyrum.*

<sup>4</sup>Proc. U. S. Nat. Mus., XIX, p. 304, 1896.

- b''*. Tube oval in section, compressed between the convex and concave sides; slowly tapering; moderately arcuate; smooth except for very fine growth lines, *D. præcursor*.

II. Shell contracted toward the aperture, which is smaller than the largest diameter of the tube; smooth, *CADULUS*.

- a*. Acicular, much attenuated posteriorly, the greatest diameter or "equator" very near the aperture.

*b*. Length 6-7 mm., about 8 times the greatest diameter, *C. phenax*.

*b'*. Length 8-12 mm., about 12 times the greatest diameter, *C. elegantissimus*.

- a'*. Slender, but not conspicuously attenuated posteriorly, the greatest diameter near the aperture, where there is a small depression on the ventral side, *C. depressicollis*.

- a''*. Stout and short, the greatest diameter near the anterior third of the length, gradually tapering toward each end; length about  $4\frac{1}{4}$  times greatest diameter, *C. colobus*.

**Dentalium Cossmannianum** n. sp. Pl. X, fig. 11; Pl. XI, figs. 10, 11.

Shell a hexagonal prism with slightly convex faces, slender, slowly tapering, moderately solid, glossy. Sculpture: there are 6 very narrow equidistant longitudinal threads, well raised and sharply defined, the wide intervals between them flat on the smaller end of the shell, but become decidedly convex toward the larger end; circular sculpture of rather strongly impressed annular growth marks at unequal intervals, sometimes close, sometimes distant. Aperture not preserved in the material before us, but apparently not oblique and with nearly circular peristome but slightly modified in shape by the longitudinal threads. Apex not known, but evidently hexagonal.

Length of (broken) type specimen 23 mm.; greatest diam. at larger end 3.5, at smaller end 2.7 mm.

The type has lost from the smaller end a considerable portion of its original length and probably somewhat less from the oral extremity. When perfect it probably measured not far from 45 or 50 mm. The portion remaining is perfectly characteristic, and unlike any Tertiary or living species of this region in the filiform riblets running from end to end, with wide convex intervals showing no intermediate longitudinal sculpture, or only the faintest traces of riblets in places, visible only under the lens at a certain angle of reflection. This is the form mentioned by Gabb under his remark on *D. dis-*

*simile*, in his paper "On the Topography and Geology of Santo Domingo," p. 244. It is named in honor of Maurice Cossmann of Paris, whose fruitful labors upon the Parisian Eocene are justly esteemed by workers upon Tertiary mollusks.

**Dentalium callioglyptum** n. sp. Pl. X, figs. 10, 12; Pl. XI, fig. 21.

Shell large, solid and but very slightly curved; noticeably compressed between the convex and concave surfaces; decidedly tapering. Sculpture, many longitudinal cords or riblets alternating with threads, altogether numbering about 65 near aperture, about 40 near the middle of the length, the ridges averaging about the width of the grooves; the whole crossed by circular raised lamellæ running a little obliquely around the tube; these lamellæ very close, nearly regular, most conspicuous in the intervals, and so fine that they are scarcely visible to the unaided eye. The circular lamellæ subobsolete toward the aperture in large specimens. Aperture slightly oblique, judging by the lines of growth; apex unknown; but according to the fragments before us both orifices are slightly oval in consequence of the compression of the tube.

Length unknown, but from the taper of the fragments probably about 115 mm.; greatest diam. of larger end of largest fragment 13, least diam. of same 12 mm., length 15 mm.

Another fragment from near the middle of the shell measures, length 30, greatest diam. of larger end 7.9, of smaller end 4.6 mm.; therefore tapering to the extent of 3.3 mm. in a length of 30 mm.

The specimens were collected by Gabb, who referred them with a "?" to his *D. affine*.

We at first thought to identify it with the recent *D. carduus* Dal, which has similar file-like circular sculpture; but upon appealing to our kind friend at Washington for a comparison, the following differential features became apparent: "*D. carduus* is lighter; the fossil form is not so much curved and the elevated lines are distant, with no longitudinal sculpture between them; the anterior part of the adult *carduus* has fine longitudinal striæ covering the interspaces as well as the elevated riblets."

*D. Tryoni* differs from this species in the character of the circular striæ and some other features mentioned below.

**Dentalium Tryoni** n. sp. Pl. X, figs. 5, 9; Pl. XI, fig. 22.

Shell long, rather slender, slowly tapering and nearly straight, the very slight curvature mainly posterior; circular in section;

quite thick and solid. Sculpture: many longitudinal threads about as wide as the intervals, alternately larger and smaller, crossed by slightly less strong, regular, blunt, encircling striæ, rising into low granules as they cross the longitudinals; these striæ are markedly oblique, bending well forward on the concave and backward on the convex side of the shell, and toward the larger end of adults becoming irregular and, in part, obsolete. Aperture and apex not preserved, but both orifices are apparently circular. Estimated length 90 mm. in a specimen having a greatest diam. of 8.5 mm.

A fragment measures: length 36, diam. at larger end 7, at smaller end 4.7 mm.

The strongly developed and decidedly oblique encircling sculpture is conspicuous and characteristic. In *D. carduus* and *D. callioglyptum* the circular sculpture consists of sharp, raised lamellæ; in *D. Tryoni* of blunt cords, more widely spaced, and with the longitudinal riblets, enclosing rhombic depressions (Pl. XI, fig. 22). In the imperfect specimen 36 mm. long, measured above, there are 33 longitudinal cords and threads at the smaller end, double that number at the larger, where some of the threads are very small. Besides the alternation in size, there is a more or less marked tendency for every fourth riblet to be larger, on the median portion of the tube. The largest of the fragments (diam. 8.5 mm.) has about 84 subequal longitudinal threads. The increase in number of riblets is by the regular intercalation of a thread in each interval, so that at various ages a specimen would have 16, 32 and 64 riblets; the increase thereafter being confined to the convex side, where the interposed threads appear earliest at each successive increase.

In the general contour *D. Tryoni* is not unlike the living *D. capillosum* Jeffr.

**Dentalium dissimile** Guppy. Pl. XI, figs. 3, 4, 5.

*Dentalium dissimile* Guppy, Quart. Journ. Geol. Soc., XXII, p. 292, pl. 17, f. 4 (1866).

*Dentalium ponderosum* Gabb, see below.

This species, described by Mr. Guppy, from the island of Jamaica, is apparently identical, as Guppy has stated, with a form collected by Gabb in San Domingo. It is a member of the "group of *D. quadruplicale*" as defined by us in the "Manual of Conchology,"<sup>5</sup>—a group distinguished by the quadrangular shape of the apex, the tube having lateral, ventral and dorsal angles posteriorly. Abund-

<sup>5</sup> Vol. XVII, p. 31.

antly developed in the Pacific, this type is not known to have living representatives in the Atlantic or Gulf of Mexico, although Miocene and Pliocene forms have been found in the southern United States.

In *D. dissimile* the tube is square at apex (Pl. XI, figs. 4, 5), but soon becomes circular in section. Each of the angles at and near the apex is pinched up into a narrow rounded rib. The intervening spaces are flat and plain near the apex, but soon a median thread or pair of threads arises, and a little later other threads appear in the intervals, until there are 30 to 36 threads, varying in size, in the girth of the tube. This sculpture then gradually becomes weaker, leaving the larger part of the tube cylindrical and smooth, except for circular striation (Pl. XI, fig. 3). The shell walls are unusually thick.

Ordinarily a specimen of mature growth loses a great part of the sculptured portion by truncation, so that the square section of the earlier part of the tube is hardly noticeable. This was the case with Guppy's type. The other characters of this species may be seen by reference to the figures here given and to Guppy's original description and figure.

Var. *ponderosum* Gabb. Pl. X, figs. 1, 2, 3; Pl. XI, figs. 15, 16.

*D. ponderosum* Gabb, Trans. Amer. Philos. Soc. (N. Ser.), XV, p. 244 (1873).

Larger, heavier, excessively solid, the cavity reduced to a small perforation by the excessive thickening of the shell. Quadrate form and accompanying sculpture very soon disappearing; form long and slender. Aperture rather oblique, the peristome, when perfectly preserved, thin and sharp.

In this remarkable form the thickness of the shell wall, when an adult is broken across the tube, is greater than the diameter of the orifice. The sculpture disappears sooner than in typical *dissimile*, and the taper of the shell is very gradual.

*Dentalium* Gabbi n. n. Pl. X, figs. 6, 7, 13; Pl. XI, figs. 1, 2.

*D. affine* Gabb, Trans. Amer. Philos. Soc. (N. Ser.), XV, p. 244 (1873). Not *D. affine* Deshayes, 1864, nor of Biondi, 1859.

Shell slightly curved near the apex, the greater part of the length nearly straight; thick, solid and strong; rapidly tapering. Sculpture prominent near apex, weak and low toward aperture. At and near the apex, hexagonal with six narrow rounded ribs at the angles, but the symmetry often impaired by the prominence of one or more of the secondary ribs; the latter lie midway between the six primary



ribs, for the greater part are decidedly smaller than these, and attain or fall short of the apex according to the age and consequent degree of posterior truncation. In the secondary intervals there arise a variable number of tertiary threads, generally one, two or three in each space; and at the aperture there is much variation in the number of riblets and threads, different specimens having 36, 40, 52, etc. In perfectly preserved shells there is seen an excessively fine but clear cut longitudinal striation in addition to the coarser sculpture described. Growth-striae fine, inconspicuous and oblique. Aperture slightly oblique, circular, the peristome bevelled to a thin edge. Apex rather wide, the orifice subcircular, with a minute notch on the convex side.

Length 41·5, diam. at aperture 7·4, at apex 2·3 mm. The largest specimen measures 8 mm. diam. at aperture.

A large, solid and markedly conical species, with very little curve, and that mainly quite near the apex. It is somewhat like *D. disparile* on a very large scale, and, as in that species, the number of ribs at the apex is subject to considerable variation, although the fundamental form is hexagonal, the tube soon becoming circular. *D. thalloides* Conrad of the Claiborne Eocene lacks the fine, clear-cut longitudinal striation of this species, and, moreover, tapers much less rapidly.

Gabb's diagnosis, published after his death, is not very full, and he gave no figure. As the name imposed by him is preoccupied, we have considered it best to present a detailed description, in proposing a new name for the form.

**Dentalium haytense** Gabb. Pl. XI, figs. 8, 9.

*D. haytensis* Gabb, Trans. Amer. Philos. Soc. (N. Ser.), XV, p. 244 (1873).

Known only by fragments, the largest of which is probably one-half the original length. These indicate an almost straight, rather rapidly tapering but slender shell, circular or nearly so in section, with smooth, polished surface; growth-wrinkles light, rather irregular, running somewhat obliquely around the tube; and there is an occasional constriction so slight as to be hardly mentionable. No trace of longitudinal sculpture. Shell moderately thick (as shown by the section, fig. 8), but becoming very thin at the aperture. Apex unknown.

Length of type (broken at both ends) 9·4, diam. at larger end 1·28 x 1·35, at smaller end 0·68 mm.

This is one of those simple species of the subgenus *Lævidentalium* which has no prominent specific characters. It is still readily distinguishable from other smooth forms of the Miocene or Oligocene of this region. *D. pyrum* is, perhaps, nearest, but that has a distinctly ovate or pear-shaped section.

*Dentalium pyrum* n. sp. Pl. XI, figs. 6, 7.

Fragments, by which alone this species is known to us, indicate a shell of slight curvature and slow increase; thin; distinctly ovate in section, compressed laterally, the narrow end of the egg-form toward the concave side. Surface smooth except for light growth-lines, polished. Apex with a narrowly oblong orifice, passing into a short, narrowly V-shaped notch on the convex side of the tube; the orifice, except at the slit, surrounded by an erect sheath.

Length of largest fragment 6.45, greatest diam. at larger end 1.8, least 1.65 mm.; diam. at smaller end 1.3 x 1.4 mm.

The apical characters are exactly as in the recent Antillean *D. perlongum* and *D. matara* Dall. It is the typical *Antalis* apex.

*Dentalium præcursor* n. sp. Pl. XI, figs. 12, 13, 14.

Shell small, thin, slowly tapering, moderately arcuate, compressed between the convex and concave sides, the section therefore oval. Surface smooth except for very fine growth-lines, without longitudinal sculpture. Dimensions of type, which is broken at both ends: length 5.6, transverse or greatest diam. at larger end .95, least .85 mm.

A member of our subgenus *Compressidens*,<sup>6</sup> but less rapidly increasing in transverse diameter than the several recent American species, among which it is most like Dall's *D. ophiodon*. We know of no allied form in the American tertiaries. It is readily distinguished from other smooth forms described herein by the vertically compressed and more arcuate tube.

*Cadulus phenax* n. sp. Pl. XI, figs. 23, 24.

Shell very slender, acicular, well curved posteriorly; rather abruptly swollen quite near the aperture, contracting rapidly anteriorly, gradually tapering posteriorly to a small apex; nearly circular in section; surface smooth, glossy, with slight growth lines but no corrugation or circular riblets posteriorly. Aperture circular, somewhat oblique; apical orifice circular with entire edge.

Length 6.5, greatest diameter 0.8 mm.

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<sup>6</sup>Type *D. pressum* Sharp & Pilsbry.



Exceedingly similar to *C. dentalinus* Guppy, of the Jamaican Oligocene,<sup>1</sup> but easily distinguished by the lack of circular riblets upon the smaller half of the tube. It differs in form from all of the smooth species of the same group. We have examined a great many specimens.

This is *Gadus dominguensis* of Gabb's paper; not of d'Orbigny.

*Cadulus elegantissimus* n. sp. Pl. XI, figs. 28, 29, 30.

Shell similar to the preceding, but larger, much more elongated. Tube compressed vertically, very obliquely but indistinctly striated, glossy. Greatest diameter close to the aperture; contraction rather slight. Aperture oval; anal orifice oval, nearly circular.

Length 11.75 mm.; greatest antero-posterior diameter of tube 0.65 mm.

A smaller specimen measures, length 8.75, greatest antero-posterior diam. 0.7 mm.

Two perfect specimens and several broken ones were included by Gabb in his lot of "*Gadus dominguensis*." It is excessively slender, quite arcuate, and decidedly longer and larger than *C. dentalinus* Guppy. The measurements are from the largest of the unbroken shells. Fragments indicate that somewhat larger individuals occur.

*Cadulus depressicollis* n. sp. Pl. XI, figs. 25, 26, 27.

Shell long and slender, arcuate, much compressed between the concave and convex sides throughout. Regularly and slowly enlarging from the apex nearly to the aperture, then noticeably contracted on all sides; on the middle of the convex side having a distinctly depressed, concave area about one-third the width of the shell, and extending from the peristome backward a distance about equal to the greatest diameter of the aperture; surface smooth and glossy. Aperture oblong; apex oblong, simple, with subcircular orifice.

Length 11.75 mm.; greatest diam. of tube 1.63, least diam. at same point 1.25 mm.; aperture, greatest diam. 1.06, least 0.8 mm.

This was one of the four species discriminated, upon separating Gabb's tray of *Gadus dominguensis* into its elementary constituents. With *Cadulus dentalinus* Guppy, *C. dominguensis* d'Orb., and the various forms associated with it, *C. depressicollis* has no close relationship. It is slender for a *Cadulus*, and remarkable for the

<sup>1</sup> Manual of Conchology, XVII, Pl. 36, figs. 1, 2.

decidedly concave area on the flattened surface adjacent to the lip on the convex side.

*Cadulus colobus* n. sp. Pl. XI, figs. 17, 18, 19, 20.

Shell small, thin, moderately curved, rather short and stout, but slightly swollen. Greatest girth at about the posterior third of the length of the tube, slowly tapering to the rather large apex, the anterior contraction equally gradual. Posteriorly the tube is strongly compressed vertically, but at the "equator" and aperture it is nearly circular in section; surface polished. Aperture circular, not oblique. Apical orifice transversely oval.

Length 2.95 mm.; diameter at "equator," antero-posterior 0.658, lateral 0.688 mm.; diam. at apex, antero-posterior 0.24, lateral 0.33 mm.; diam. of aperture 0.55 x 0.58 mm.

*C. colobus* is a much smaller and more "stumpy" species than *C. parianus* Guppy of the Trinidad Oligocene. It is very unlike *C. dentalinus*, *elegantissimus* or *depressicollis*. It was found with Gabb's lot of "*Gadus dominguensis*."

#### VERMES—SERPULIDÆ.

"*Dentalium rudis*" Gabb. Pl. X, figs. 4, 8.

? *Dentalium rudis* Gabb, Trans. Amer. Philos. Soc. (n. ser.), xv, p. 244 (1873).

The fossils referred doubtfully to *Dentalium* under the above name are unquestionably the tubes of a worm of the family *Serpulidæ*. The fragments indicate an almost straight, tapering tube with no trace of lateral attachment to other bodies. It is thick and seems to consist of three layers of different structure or composition. Externally there are eight rude, strongly convex longitudinal ridges separated by narrow grooves, and rendered irregular by rather numerous impressed lines running circularly around the tube, and occasional constrictions also irregular in occurrence. The ribs run almost straight, on some of the fragments, slowly spiral on others, the torsion being opposite in direction to that of the thread of an ordinary screw. The largest fragment measures, length 22, diam. at large end 7, at smaller end 5 mm.

The measurement given by Gabb was from a number of fragments from several individuals fitted together according to the taper (as in fig. 4), and as the latter seems rather regular, his result is probably not far from the truth.

In the present condition of the literature upon tubicolous worms, it is impossible for us to determine the generic position of these remains, but we take them to be something of the nature of *Ditrupa*, *Hamulus* or *Pyrgopolon*; the massive, sculptured tube being not unlike the Cretaceous groups mentioned.

## EXPLANATION OF PLATES.

### PLATE X.

(All figures natural size).

- Figs. 1, 2, 3. *Dentalium dissimile* var. *ponderosum* Gabb.  
Fig. 4. "*Dentalium rudis*" Gabb. Fragments of three individuals.  
Fig. 5. *Dentalium Tryoni* n. sp.  
Figs. 6, 7. *Dentalium Gabbi* n. sp.  
Fig. 8. "*Dentalium rudis*" Gabb. Fragment.  
Fig. 9. *Dentalium Tryoni* n. sp.  
Figs. 10, 12. *Dentalium callioglyptum* n. sp.  
Fig. 11. *Dentalium cossmannianum* n. sp.  
Fig. 13. *Dentalium Gabbi* n. sp.

### PLATE XI.

- Figs. 1, 2. *Dentalium Gabbi* n. sp. Enlarged view of the apex.  
Fig. 3. *Dentalium dissimile* Guppy. Enlarged view of anterior portion.  
Fig. 4. *Dentalium dissimile* Guppy. Enlarged view of posterior end.  
Fig. 5. *Dentalium dissimile* Guppy. Enlarged view of apex.  
Fig. 6. *Dentalium pyrum* n. sp. Enlarged view of aperture.  
Fig. 7. *Dentalium pyrum* n. sp. Ventral aspect, enlarged.  
Fig. 8. *Dentalium haytense* Gabb. Aperture, enlarged.  
Fig. 9. *Dentalium haytense* Gabb. Lateral aspect, enlarged.  
Fig. 10. *Dentalium Cossmannianum* n. sp. Lateral aspect of anterior portion.  
Fig. 11. *Dentalium Cossmannianum* n. sp. Section, enlarged.  
Fig. 12. *Dentalium præcursor* n. sp. Aperture, enlarged.  
Fig. 13. *Dentalium præcursor* n. sp. Lateral aspect, enlarged.  
Fig. 14. *Dentalium præcursor* n. sp. Dorsal aspect, enlarged.

- Figs. 15, 16. *Dentalium dissimile* var. *ponderosum* Gabb. Two sections of one individual (Pl. X, fig. 2) enlarged.
- Fig. 17. *Cadulus colobus* n. sp. Dorsal aspect, much enlarged.
- Fig. 18. *Cadulus colobus* n. sp. Aperture.
- Fig. 19. *Cadulus colobus* n. sp. Lateral aspect.
- Fig. 20. *Cadulus colobus* n. sp. Anal orifice.
- Fig. 21. *Dentalium callioglyptum* n. sp. Sculpture, much enlarged.
- Fig. 22. *Dentalium Tryoni* n. sp. Sculpture, much enlarged.
- Figs. 23, 24. *Cadulus phenax* n. sp. Lateral aspect.
- Fig. 25. *Cadulus depressicollis* n. sp. Outlines of aperture and "equator."
- Fig. 26. *Cadulus depressicollis* n. sp. Lateral aspect.
- Fig. 27. *Cadulus depressicollis* n. sp. Ventral aspect.
- Fig. 28. *Cadulus elegantissimus* n. sp. Lateral aspect.
- Fig. 29. *Cadulus elegantissimus* n. sp. Outline of aperture.
- Fig. 30. *Cadulus elegantissimus* n. sp. Lateral aspect.